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Cell death assessment in *Oxalis corniculata* Linn. under Aluminium (Al) stress supplemented with Silicon (Si)

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ABSTRACT

Oxalis corniculata Linn is one of the known useful medicinal plant commonly known as yellow wood sorrel which has been used since ages for the treatment of various ailments and also used as a food at the time of scarcity. Under acidic condition, Aluminium(Al) toxicity is one of the potential growth-limiting factor for plants among the abiotic factors. Silicon (Si) is one of the most prevalent macroelements found in soil, can improve the condition of soils. In the present study experiments were conducted for cell death assessment in *Oxalis corniculata* Linn. The experimental setup was completely randomized with three treatments (0, 1.6 mmol/L Al, and 1.6 mmol/L Al + 2.0 mmol/L Si; being described as the control, Al toxicity and Al toxicity + Si, respectively). Treatments were given for two time intervals – 2hrs and 4hrs. The loss of cell viability or cell death was evaluated using Evan's blue staining method. The result showed plants that were aluminium stressed showed higher cell death as compared to control when the treatments were given for 2hrs and 4hrs on the other hand Si application results in lesser cell death for both the treatments (2hrs and 4hrs) as compared to aluminium stressed plants.

Key words - *Oxalis corniculata* Linn., Aluminum toxicity, Silicon, Evans blue, Cell death.

INTRODUCTION

India is a versatile emporium of medicinal plants where herbal medicines have been the basis of treatment and cure for various diseases. Oxalis is considered as the largest genus in the wood-sorrel family Oxalidaceae consisting of approximately 900 known species (S.K Pathak and J. Kumar, 2018). The plant *Oxalis corniculata* Linn. is one of the known useful medicinal plant commonly known as yellow wood sorrel. It has been used since ages for the treatment of various ailments like kapha, vata, piles, dysentery, diarrhoeas, skin diseases and quarten fevers and also used as a food at the time of scarcity (S. Saha, 2017; S. Merugu and et al., 2012). Aluminium(Al) is one of the most abundant metals in the earth's crust occupy nearly 40% of the world's arable lands (V.M.M Achary and et al., 2008). Among the abiotic factors affecting plants, Aluminium(Al) toxicity is a potential growth-limiting factor for plants grown in acid soils particularly in pH of 5.0 or below in which the phytotoxic form Al3+ predominates (C. Ouyang and et al., 2014; B. Meriga and et al., 2010). Although Silicon(Si) has not been classified as an essential element it has been considered as beneficial element for the plants as it enhances the quantitative and qualitative traits of plants, especially under environmental stresses like heavy metal toxicity (Y.X Zhu and et al., 2019; C.H.C Malhotra and et al., 2016). Si can improve the condition of soils,which contain toxic levels of heavy metals like - Fe, Al, Mn making it a high-quality fertilizer for promoting ecologically sound agricultural practices (M. Sahebi and et al., 2015; M.D.R Lima and et al., 2016; R.M, Britez and et al., 2002). Based on this overview, our hypothesis is that Si must reduce the negative impacts of Al in Oxalis corniculata Linn. The aim of this research work is cell death assessment under Al toxicity and determine if Si can improve the tolerance mechanism of Oxalis corniculata Linn. exposed to Al toxicity.

Objective

Cell death assessment in Oxalis corniculata Linn. under Aluminium (Al) stress supplemented with Silicon (Si).

Materials and Methods

Plants were collected from the Botanical Garden of Ranchi University, Ranchi. The experimental setup was completely randomized with three treatments (0, 1.6 mmol/L Al, and 1.6 mmol/L Al + 2.0 mmol/L Si; being described as the control, Al toxicity and Al toxicity + Si, respectively). Treatments were given for two different time intervals – 2hrs and 4hrs (Lima M.D.R and et al. 2016). For cell death assessment freshly harvested roots from both the treatments and control were taken and stained with 0.25% (w/v) aqueous solution of Evans blue for 15min. Then washed with distilled water for 30 minutes. After that roots of equal length were excised and soaked with 4ml of N,N - dimethylformamide for 1hr. And lastly absorbance measured at 600nm (V.M.M Achary and et al., 2008).

Result

There is a change in cell death of *Oxalis corniculata* Linn. under both the experimental conditions (Al toxicity, Al toxicity+Si) in both the time intervals (2hrs and 4hrs). This result can be explained by the following table and column graph (Table: 1 and Figure: 1). For 2hrs duration the calculated value for cell death under control condition is 0.03 while for the treated plants Al toxicity and Al toxicity + Si, this value is 0.08 and 0.05 respectively. While for 4hrs duration the calculated value for cell death under control condition is 0.03 while for the treated plants Al toxicity and Al toxicity + Si, this value is 0.16 and 0.03 respectively. Results of Al toxicity + Si treatment plants have shown significant lesser cell death as compared to plants that are exposed to Al toxicity for both the time duration - 2hrs and 4hrs. Results are clearly showing high cell death in Al stressed plants as compared to control and Al stressed+Si treated plants.

Table 1: Showing absorbance for cell death in Oxalis corniculata Linn. in control as well as treated with Al Stress and Al Stress + Si.

Duration	Control	Al Stressed	Al Stressed + Si
2 Hr.	0.03	0.08	0.05
4 Hr.	0.03	0.16	0.03

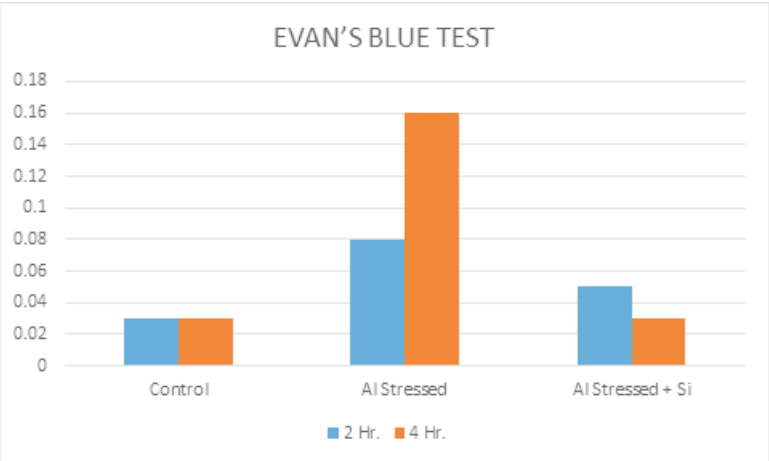

Figure 1: Column graph showing comparative cell death in Oxalis corniculata Linn. in control as well as treated with Al stress and Al stress + Si.

Discussion and Conclusion

The result showed that the plants that were aluminium stressed showed higher cell death as compared to control when the treatments were given for 2hrs and 4hrs. On the other hand Si application exhibited beneficial effects for both the treatments (2hrs and 4hrs) over Al stressed plants. On the basis of above findings, it may be concluded that Aluminium stress exerted an adverse effect on plant Oxalis corniculata Linn.while Si exhibits beneficial effects.

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